

Remarks

Applicants first apologize for inadvertently including claim 9 in the Amended Claims previously submitted as an original claim. Claim 9 had been cancelled in a response to an Office Action mailed on December 22, 2002. Attached are Amended Claims that, in addition to amendments discussed hereinbelow, reflect the current status of the claims, with claim 9 indicated as being cancelled.

Claim 2 is cancelled, with its subject matter the basis of amendments to claims 1 and 8.

The present invention is based on the recognition that ultradeep hydrodesulfurization requires the removal of alkylated benzothiophenes, which are much more difficult to remove than are other sulfur compounds, such as the sulfides and disulfides, and the thiophenes. This is explained in the application at page 2, lines 7 to 21. Thus, the required catalyst activity for the desulfurization to a level of 50 ppm is more than five times the activity required for a desulfurization to 500 ppm. This is explained in the declaration of Plantenga, which was filed earlier.

It is believed that the removal of alkylated benzothiophenes also proceeds by a different mechanism than the removal of other sulfur compounds. This is illustrated by the test results submitted with the previously submitted Declaration of van Houtert. The data show that for desulfurization to a level between 200 and 500 ppm (which could be referred to as deep hydrodesulfurization), a catalyst comprising cobalt, molybdenum, and an additive is more active than the corresponding catalyst comprising nickel and molybdenum. With the former a sulfur level of 217 ppm is obtained, with the latter the final sulfur level is 352 ppm. For hydrodesulfurization to a level below 100 ppm (which could be called ultradeep hydrodesulfurization) the picture is the exact opposite. In this context the nickel molybdenum catalyst is far superior, reaching a sulfur level of 10 ppm, whereas the cobalt molybdenum catalyst reaches only 67 ppm sulfur.

With the amendments presented herewith, the claims have been limited to a hydrodesulfurization process whereby the sulfur level is reduced to less than 50 ppm. This is consistent with the amendment introduced earlier, requiring a nickel molybdenum catalyst for this hydrodesulfurization process.

Rejections under 35 USC 103(a).

Claims 1, 2, and 7 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the Kamo et al. reference (U.S. 5,162,281). Applicants submit that this rejection has been overcome with the present amendment.

The examiner has acknowledged that the reference does not disclose the levels of sulfur in the products obtained with the catalysts of the Kamo reference. The focus of this reference is the effect of a sulfur-containing additive on the relative performance of the catalysts. Referring to table 1 of the reference, catalyst K represents the comparative example. Although the absolute performance of the catalysts is not known, it is clear that the sulfur additives of this reference at best provide a performance improvement of 65 percent (compare catalyst A and catalyst K). This is insufficient to improve the performance from deep hydrodesulfurization to ultra-deep hydrodesulfurization. This is confirmed by the relative performance of catalysts E and F, the only molybdenum nickel catalysts in the test. Although these catalysts perform well, they do not reach the performance level of, for example, catalyst A or catalyst I, both of which are molybdenum cobalt catalysts. Based on these data, the skilled person would not be induced to focus single-mindedly on molybdenum nickel catalysts in order to obtain sulfur levels of below 50 ppm.

Furthermore, the Kamo reference teaches away from the present invention by requiring the presence of an organic sulfur compound. The reason why the presence of this sulfur compound is considered essential is explained in column 4, lines 41 to 64. According to this reference, a pre-sulfurization step is less effective than the

addition of a sulfur compound. This teaches away from the process of the present invention, which in fact specifically requires a pre-sulfurization step.

Claims 1-5, 7, 8, and 10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yamaguchi et al. (U.S. 5,468,709).

Like the Kamo reference, the Yamaguchi reference does not disclose the sulfur levels obtained with the catalysts of the examples. However, the hydrodesulfurization activity of these catalysts can be estimated from the formula provided at col. 10, line 27. The performance of catalyst AAI is set as 100 for a reference point to the other catalysts. See col. 10, line 53. If we assume a sulfur concentration in the feed oil of 1.5 percent, and a sulfur concentration in the treated oil as obtained with catalyst AAI of 500 ppm, the formula allows us to calculate the rate constant as -8.8. A hydrodesulfurization to a sulfur level of 200 ppm corresponds to a rate constant of -16.9, or a relative value of 192. Likewise, for a final sulfur level of 150 ppm the relative value of the rate constant is 236, and for an endpoint of 100 ppm the relative value would be 317. Comparing these numbers to those provided in table 3 of the reference, it appears that the best performing catalysts would have produced a sulfur level of slightly lower than 150 ppm, but well above 100 ppm. It is clear that the performance of these catalysts does not approach that of the process of the present claims.

The examples in the Yamaguchi reference focus on both hydrodesulfurization and hydrodenitrogenation. All of the exemplified hydrodesulfurization catalysts are cobalt molybdenum catalysts, whereas all nickel molybdenum catalysts are used in hydrodenitrogenation. Clearly, the reference does not suggest that nickel molybdenum catalysts might be preferred for ultradeep hydrodesulfurization. To the contrary, the overwhelming weight of the data in the reference would lead one to conclude that cobalt molybdenum is the preferred catalyst for hydrodesulfurization. This is, of course, consistent with the data presented in the van Houtern declaration, which showed that cobalt molybdenum is the better performing catalyst in the deep hydrodesulfurization range.

Claims 1-8 and 10 have been rejected under 35 U.S.C. 103(a) as being unpatentable over EP 0 870 817 A1 in view of the Yamaguchi reference. The examiner's argument is that it would have been obvious to use the additives disclosed in Yamaguchi to improve the performance of the catalyst of the EP reference.

The EP reference, unlike the Yamaguchi reference, recognizes that for the removal of the final remaining sulfur compounds of a hydrocarbon feedstock a different type of catalyst is needed than what is used for normal hydrodesulfurization. The EP reference seeks to modify the properties of a hydrodesulfurization catalyst by using a carrier comprising silica. The reference recognizes that silica has the undesired side effect of promoting hydrocracking (see page 2, lines 17 to 18). Yamaguchi, on the other hand, seeks to improve the performance of a regular hydrodesulfurization catalyst by using an organic additive.

Since the catalysts of Yamaguchi operate in a one step process, whereas the EP reference employs a two step process, it is not appropriate to combine the teachings of the two references. The first reference seeks to improve the traditional, one step hydrodesulfurization process with an organic additive in the catalyst. The second reference takes a different approach, by providing a two-step process with a conventional hydrodesulfurization step followed by a second step with a catalyst specifically designed for this second step.

Even if the teachings of the two references can be properly combined, it is not clear what the result of the combined teachings would be. The most logical result of the combined teachings is to use the additive of Yamaguchi in the catalyst of the first step of the EP reference. One would not be inclined to add an additive of Yamaguchi to the catalyst of the second step of the EP reference, because the EP reference teaches that the second step requires a different mechanism. There is nothing in the Yamaguchi reference to suggest that the additive would be helpful or beneficial in this different type reaction.

Even if one were to conclude that the combined teachings would lead one to introduce the Yamaguchi additive into the catalyst of the second step of the EP reference, it is clear that this catalyst would be a cobalt molybdenum catalyst. As discussed hereinabove, the Yamaguchi reference clearly favors cobalt molybdenum catalysts for the hydrodesulfurization reaction. The EP reference does not express a preference, but the sole example uses a cobalt molybdenum catalyst in the second step (see p. 4, lines 49 to 50). With both references favoring the cobalt molybdenum combination, their combined teachings would lead one to a cobalt molybdenum catalyst, not to the nickel molybdenum catalyst of the present claims.

Double patenting rejections

Claims 1, 2, 6, and 7 have been rejected under the doctrine of obviousness type double patenting. The examiner's position is that each set of claims is drawn to a hydrotreating process in which a feed is contacted with a catalyst that contains the hydrogenation metals and an organic additive.

This rejection is respectfully traversed. The hydrocarbon feed of the '908 patent is not a feed having less than 500 ppm sulfur. To the contrary, the preferred feed has a sulfur content of at least 0.2 weight percent (see claim 12 of the '908 patent). There is no disclosure in the '908 patent that the hydrodesulfurization process results in a sulfur content of less than 50 ppm. Finally, the preferred combination of metals for the hydrodesulfurization activity of the catalyst is a combination of cobalt with molybdenum (see, 5, lines 44 to 47.) The present invention therefore is not obvious over the disclosures of the '908 patent, and therefore the double patenting rejection is improper.

Claims 1, 2, 7, 8, and 10 have been provisionally rejected under the doctrine of obviousness type double patenting as being unpatentable over the claims of co-pending application number 09/942830. This is a provisional double patenting rejection because

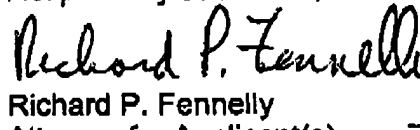
the conflicting claims have not in fact been patented. Applicants are prepared to resolve any actual conflict by filing the appropriate terminal disclaimer.

Conclusion

The present invention is not obvious over the cited prior art and issues concerning double patenting are traversed, or will be resolved in the future.

It is respectfully requested that instant claims 1-8 be allowed and that the present application proceed to issue in due course.

Respectfully submitted,



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